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(54) LIGHT METAL ALLOY INJECTION-MOLDING MATERIAL, PRODUCTION THEREOF AND LIGHT ALLOY FORGED PRODUCT

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the plastic workability by using a light metal composed of Al and Mg as alloy components as a base material and containing α-phase in Mg primary crystal having a specific value or lower of grain diameter.
SOLUTION: Particularly, the base material of the light metal alloy is Mg and as the alloy component, and Al is desirable to contain at least 5 wt.%. At the time of injection-forming under semi-melting state having ≤70% solid phase ratio, the grain diameter of the α-phase in the Mg primary crystal becomes ≤120 μm and the uniformizing treatment effect is favorably exhibited. The condition of the uniformizing treatment is selected in such sufficient ranges of 300-500° C and 30 min-10 hr that Mg-Al compound existing in the grain boundary of the injection-formed product forms a solid solution in the base material. That is, these temp. and time are decided under consideration grain diameter and quantity of the Mg-Al compound and mass of the formed product. Since the obtd. light metal alloy injection formed material has the formability of ≥60% the limit upsetting ratio, the light alloy forged product can be produced by applying the direct forging process.

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CLAIMS

[Claim(s)]
[Claim 1] Light metal alloy injection-molding material which uses as a base material the light metal which makes aluminum and magnesium an alloy content at least, and is characterized by including a magnesium primary-phase alpha phase with a particle size of 500 micrometers or less.
[Claim 2] Injection-molding material according to claim 1 which a base material is magnesium, 5 % of the weight or more of aluminum is contained at least as an alloy content, and is 200 micrometers or less of diameters of average crystal grain.
[Claim 3] Injection-molding material according to claim 1 which a magnesium primary-phase alpha phase is 120 micrometers or less in particle size, and comes to dissolve to a base material with homogenization heat treatment in a MgAl compound substantially.
[Claim 4] The manufacture method of the light metal alloy injection-molding material characterized by carrying out injection molding and carrying out homogenization heat treatment of the moldings after making into a melting state the light metal alloy which makes aluminum and magnesium an alloy content at least at the temperature of the half-melting state where solid phase/liquid phase lives together, or the melting point right above of an alloy.
[Claim 5] The manufacture method according to claim 4 that a base material is magnesium and a light metal alloy contains 5 % of the weight or more of aluminum at least as an alloy content.
[Claim 6] The manufacture method according to claim 4 by which injection molding of the light metal alloy is carried out in the state of half-melting of 70% or less of rates of solid phase.
[Claim 7] The manufacture method according to claim 4 which is within the limits of 30 minutes - sufficient 300-500 degree-Cx 10 hours for making the MgAl compound with which homogenization heat treatment conditions exist in the grain boundary of an injection-molded product dissolve to a base material.
[Claim 8] The light alloy forging product manufactured by giving light metal alloy injection-molding material according to claim 3 to the forging process of 60% or more of rates of swaging.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the injection-molding material excellent in the moldability of a light metal alloy, especially the Magnesium alloy which contains aluminum as an alloy content, its manufacture method, and a light alloy forging product.

[0002]

[Description of the Prior Art] The light metal alloy which uses aluminum or magnesium as a base material, especially the Magnesium alloy which makes aluminum an alloy content are lightweight, and attracts attention by performing plastic working, such as forging, as a material which can secure a predetermined mechanical strength. However, it is difficult for the cast cast in the mold with the usual dissolution casting for plastic-working nature, such as forging, to be missing and to secure a predetermined mechanical strength.

[0003]

[Problem(s) to be Solved by the Invention] Then, if it searches for the cause by which this plastic-working nature is missing in the light metal alloy containing aluminum and MAGUNESHIMU, when aluminum and MAGUNESHIMU coexist [1st], the compound shown in a grain boundary with aluminum12Mg17 generates, and this affects plastic-working nature. On the other hand, although there is no MAGUNESHIMU primary-phase alpha phase in the cast cast with dissolution casting, a MAGUNESHIMU primary-phase alpha phase exists in the mold goods which injection molded in the state of half-melting with which solid phase/liquid phase coexists. Therefore, the existence or nonexistence of this primary-phase alpha phase ease the influence of the above-mentioned AlMg compound, and are considered to affect improvement in plastic-working nature. Although the rate of solid phase which are solid phase / liquid phase ratio follows the particle size of the primary-phase alpha phase of the above-mentioned magnesium on becoming small and it becomes small the 2nd, the improvement in plastic-working nature is not accepted so much only by it. However, it was found out the ** case given to homogenization heat treatment that plastic-working nature improves remarkably by short-time processing. This is the effect which was not accepted in dissolution casting.

[0004] Then, the 1st purpose of this invention is to offer the light metal alloy injection-molding material which has the primary-phase alpha phase of the magnesium which raises plastic-working nature, its manufacture method, and a light alloy forging product. The 2nd purpose of this invention is to offer the light metal alloy injection-molding material which can raise plastic-working nature with homogenization heat treatment, its manufacture method, and a light alloy forging product.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention uses as a base material the light metal which makes aluminum and magnesium an alloy content at least, and the light metal alloy injection-molding material which is excellent in the moldability characterized by including a magnesium primary-phase alpha phase with a particle size of 500 micrometers or less is offered. In order to make the primary-phase alpha phase of magnesium generate, it is necessary to perform injection molding based on a half-melting injection-molding method. Here, after making injection molding by the half-melting injection-molding method into a melting state at the temperature of the half-melting state where solid phase/liquid phase lives together, or the melting point right above of an alloy, it means carrying out injection molding.

[0006] When a base material is magnesium, 5 % of the weight or more of aluminum is contained at least as an alloy content, and it is desirable that it is 200 micrometers or less of diameters of average crystal grain. At less than 5 % of the weight, it is because mechanical strength predetermined in aluminum is not obtained. Therefore, in this invention, AZ61 and AZ80 of ASTM specification, AZ91 grade, and a Mg-aluminum-Zn system alloy are mentioned as a desirable Magnesium alloy. Moreover, it is because the rate of a marginal **** lump at the time of the forging whose diameter of average crystal grain is one of the plastic-working nature in 200 micrometers or more becomes 50% or less.

[0007] In the conventional dissolution casting, improvement in the moldability which was not obtained is accepted (refer to drawing 1), and especially the injection-molding material that a magnesium primary-phase alpha phase is 120 micrometers or less in particle size, and comes to dissolve to a base material with homogenization heat treatment in a MgAl compound substantially can give injection-molding material to direct forging fabrication, and can simplify the process which results in forging.

[0008] this invention also offers the manufacture method of the light metal alloy injection-molding material characterized by carrying out injection molding and carrying out homogenization heat treatment of the moldings, after making a melting state the light metal alloy which makes aluminum and magnesium an alloy content at least at the temperature of the half-melting state where solid phase/liquid phase lives together, or the melting point right above of an alloy.

[0009] A magnesium primary-phase alpha phase serves as particle size of 120 micrometers or less, and especially this invention method is homogenization heat, when a light metal alloy has it when a base material is magnesium and contains 5 % of the weight or more of aluminum at least as an alloy content, and injection molding is carried out in the state of half-melting of 70% or less of rates of solid phase. [effective]

[0010] The conditions of homogenization heat treatment are chosen within the limits of 30 minutes - sufficient 300-500 degree-Cx 10 hours for making the MgAl compound which exists in the grain boundary of an injection-molded product dissolve to a base material. That is, you should take into consideration the particle size of a MgAl compound and (it is related to an alloy content) an amount, the mass of mold goods, etc.

[0011] Since the light metal alloy injection-molding material obtained by this invention has the moldability of 60% or more of rates of marginal swaging, it can be given to a direct forging process and can manufacture a light alloy forging product.

[0012]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. The Magnesium alloy of AZ80 which has the following

composition was prepared, and injection molding was performed to the bottom of the following condition using the half-melting injection molding machine (form :JLM- 450E, Japan Steel Works Make) shown in drawing 3 . this injection molding machine -- a top [temperature / solidus-line / of a molding material] -- it is -- the temperature below liquidus-line temperature -- the inside of a screw extruder -- an alloy -- heating -- a half-melting state -- carrying out -- a high-speed catapult style -- metal mold -- a shot is carried out into a cavity

[0013]

[Table 1]

Magnesium alloy composition (unit : % of the weight)

aluminum Zn Mn Fe Si Cu nickel Mg Alloy A 8.1 0.45 0.27 0.0018 0.03 0.0025 0.0009 Bal.

[0014]

[Table 2] Injection-molding condition injection pressure 80MPa injection speed 2 m/sec gates speed 48 m/sec die temperature 180 degrees C [0015] Although the Magnesium alloy was cut and it was supplied to the shape of a chip, nothing, and the hopper, the rate of solid phase (solid phase/liquid phase) was adjusted at the heating temperature in a cylinder. While checking the success or failure of the primary-phase alpha phase of the injection-molded product in the various rates of solid phase with the microphotography, the mean particle diameter was measured. A result is as in the following table 3.

[0016] Moreover, material [above-mentioned having carried out injection molding] and the material which carried out homogenization heat treatment (for [400 degree-Cx] 180 minutes) back air cooling were examined by the following forging moldability evaluation methods. Consequently, although it becomes the primary-phase alpha phase of 120 micrometers or less at 70% or less of rates of solid phase and the particle size of a primary-phase alpha phase becomes small with decline in the rate of solid phase, most improvement in a moldability is not found. However, a primary-phase alpha phase is the homogenization heat from 120 micrometers or less. The method of evaluating by the rate of a marginal **** lump for which was set and it asked by lump examination using the pillar-like test piece as the above-mentioned forging moldability evaluation method was used. That is, a pillar-like test piece with a diameter [of 16mm] and a height of 24mm is set in the height direction, and is forged, height H in case the crack of a test piece arises is measured, and they are the following formulas (I).

[Equation 1]

Rate (%) of marginal **** lump =(24-H) (/24) x100 (I)

In quest of the rate of a marginal **** lump, it evaluated more.

[0017]

[Table 3]

A primary-phase alpha phase and forging moldability The rate of solid phase 10% 20% 40% 70% 80% Primary-phase alpha phase Mean particle diameter (micrometer) 45 35 75 120 140 The 1st moldability 70% 66% 64% 60% 57% The 2nd moldability 87% 85% 72% 62% 56%, in addition, the 1st moldability means the moldability (rate of a marginal **** lump) in 300 degrees C before homogenization heat treatment, and the 2nd moldability means the moldability (rate of a marginal **** lump) in 300 degrees C after homogenization heat treatment.

[0018] When the above result is made into a graph, it is as being shown in drawing 1 . Moreover, when the case where continuous casting of the Magnesium alloy of the same composition as 10% of rates of solid phase and 70% of case is carried out for change of the

moldability before and behind homogenization heat treatment is compared, it is as being shown in drawing 2 . that is, except this invention, since existence of a primary-phase alpha phase is not accepted, it does not accept, but the homogenization heat treatment effect begins to be demonstrated at 70% or less of rates of solid phase also by the case of this invention, the particle size of the **** primary-phase alpha phase to which the rate of solid phase falls becomes small, and the moldability of the effect of homogenization heat treatment improves gradually -- things are accepted

[0019] If D (drawing 7) is compared using the above-mentioned Magnesium alloy the half-melting injection-molding material B (drawing 5) which injection molded at the half-melting injection-molding material A (drawing 4) which injection molded at 10% of rates of solid phase, and 70% of rates of solid phase, when [C] die casting is carried out (drawing 6), and when metal mold casting (continuous casting) is carried out, in the case of back 2 persons, in front 2 persons, a primary-phase alpha phase will not be accepted in a primary-phase alpha phase being accepted.

[0020] Moreover, in the above-mentioned half melting injection-molding material A and B, it receives Mg17aluminum12 compound which exists in a grain boundary with comparatively short homogenization heat treatment of 3 hours at 400 degrees C almost dissolving, and disappearing (referring to drawing 8 and drawing 9), and in the metal-mold-casting material D, even if it performs homogenization heat treatment at 400 degrees C for 6 hours, it hardly dissolves (refer to drawing 10). This result has appeared in the existence or nonexistence of improvement in the moldability of homogenization heat treatment.

[0021] although various effects were checked about AZ80 Magnesium alloy above, as long as injection molding of the light alloy containing magnesium and aluminum is carried out by the half-melting injection-molding method, crystallization of the primary-phase alpha phase of this magnesium is carried out Moreover, as long as dissolution casting of the light metal alloy containing magnesium and aluminum is carried out, Mg17aluminum12 compound which exists in a grain boundary deposits. Therefore, this invention method is applicable to the light metal alloy which contains magnesium and aluminum widely.

[0022]

[Effect of the Invention] As explained above, in the light alloy which contains magnesium and aluminum at least according to this invention, the primary-phase alpha phase of magnesium exists with injection molding, and the moldability which was excellent as compared with continuous casting is shown. Since Mg17aluminum12 compound which deposits in a grain boundary dissolves to a base material with homogenization heat treatment and disappears especially when the above-mentioned primary-phase alpha phase is 120 micrometers or less, the more excellent moldability will be shown. By using such this invention injection-molding material, forging fabrication becomes easy and can offer the forging of a Magnesium alloy.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The graph which shows the relation of the mean particle diameter of the rate of solid phase in half-melting injection molding of AZ80 Magnesium alloy, and a primary-phase alpha phase, and the moldability before and behind homogenization heat treatment.
[Drawing 2] The graph which contrasted the effect exerted on the moldability before and behind homogenization heat treatment by this invention, and the effect exerted on the moldability before and behind homogenization heat treatment in continuous casting.
[Drawing 3] It is the schematic diagram of the half-melting making machine used by this invention.
[Drawing 4] It is the microphotography in which the organization of the half-melting injection-molding material A which injection molded at 10% of rates of solid phase is shown.
[Drawing 5] It is the microphotography in which the organization of the half-melting injection-molding material B which injection molded at 70% of rates of solid phase is shown.
[Drawing 6] It is the microphotography in which the organization of the die-casting material of AZ80 Magnesium alloy is shown.
[Drawing 7] It is the microphotography in which the organization of the metal-mold-casting material of AZ80 Magnesium alloy is shown.
[Drawing 8] It is the microphotography in which the organization after carrying out homogenization heat treatment of the half-melting injection-molding material shown by drawing 4 is shown.
[Drawing 9] It is the microphotography in which the organization after carrying out homogenization heat treatment of the half-melting injection-molding material shown by drawing 5 is shown.
[Drawing 10] It is the microphotography in which the organization after carrying out homogenization heat treatment of the half-melting injection-molding material shown by drawing 7 is shown.

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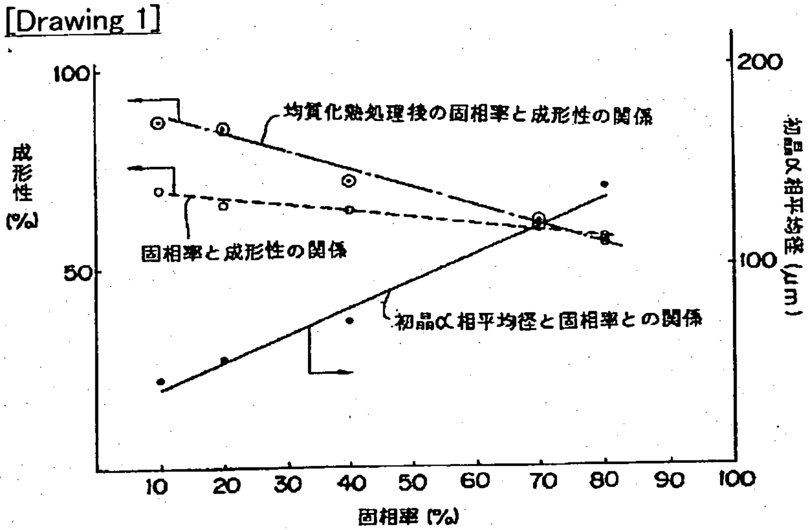
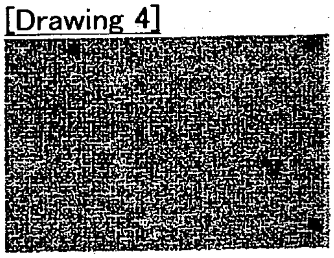
DRAWINGS

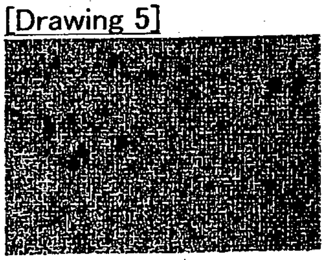
[Drawing 1]



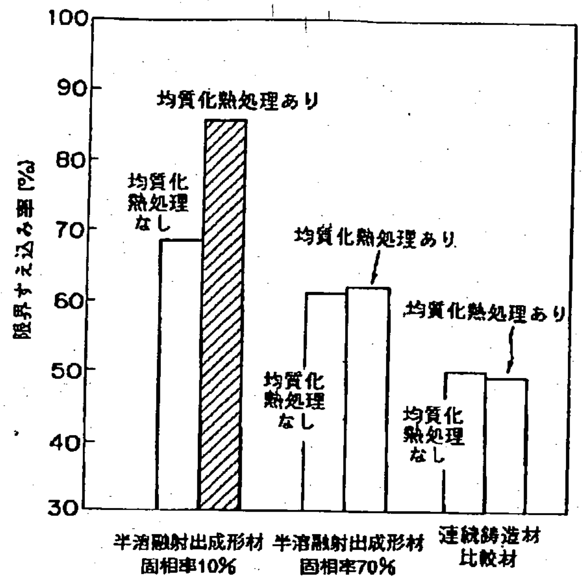
[Drawing 4]



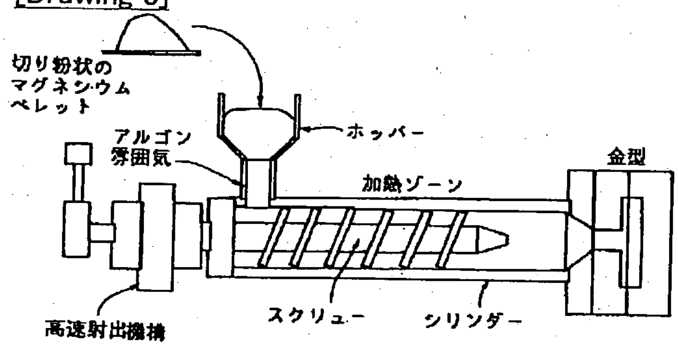
[Drawing 5]



[Drawing 2]



[Drawing 3]



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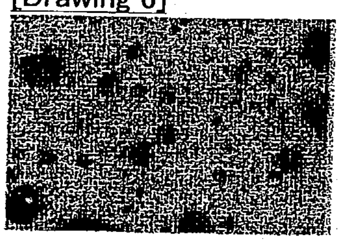
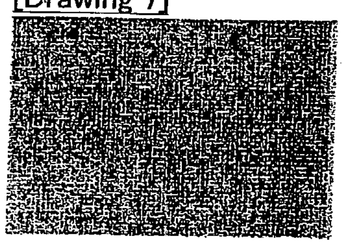
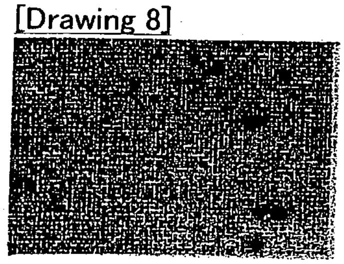


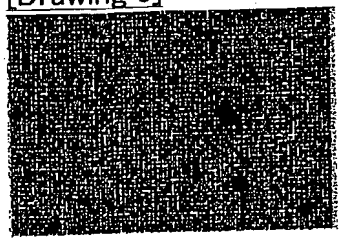
[Drawing 7]



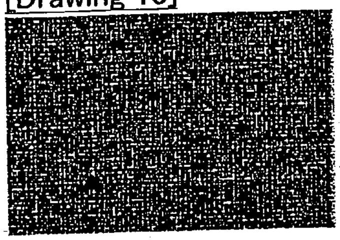
[Drawing 8]



[Drawing 9]



[Drawing 10]



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(84) Designated contracting states:

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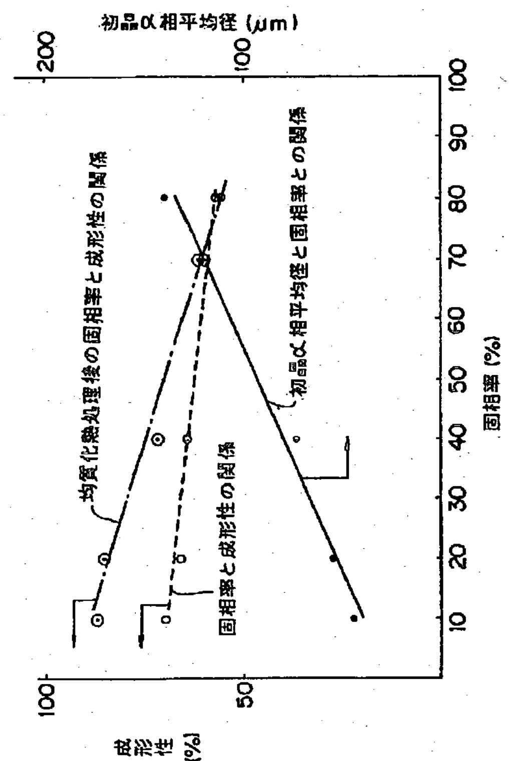
(54)【発明の名称】　軽金属合金射出成形材およびその製造方法並びに軽合金鍛造製品

(57)【要約】

【課題】　塑性加工性を向上させるマグネシウムの初晶α相を有する軽金属合金射出成形材およびその製造方法並びに軽合金鍛造製品を提供すること。

【解決手段】　少なくともアルミニウムおよびマグネシウムを合金成分とする軽金属を母材とし、粒径５００μm以下のマグネシウム初晶α相を含有することを特徴とする成形性に優れる軽金属合金射出成形材であって、特に粒径１２０μm以下の場合は均質化熱処理によりさらに成形性が向上することを特徴とする。



【特許請求の範囲】

【請求項１】　少なくともアルミニウムおよびマグネシウムを合金成分とする軽金属を母材とし、粒径５００μm以下のマグネシウム初晶α相を含むことを特徴とする軽金属合金射出成形材。

【請求項２】　母材がマグネシウムであって、合金成分として少なくともアルミニウム５重量％以上を含有し、平均結晶粒径２００μm以下である請求項１記載の射出成形材。

【請求項３】　マグネシウム初晶α相が粒径１２０μm以下であって、均質化熱処理にて実質的にＭｇＡｌ化合物を母材に固溶してなる請求項１記載の射出成形材。

【請求項４】　少なくともアルミニウムおよびマグネシウムを合金成分とする軽金属合金を固相／液相が共存する半溶融状態あるいは合金の融点直上の温度で溶融状態とした後、射出成形し、その成形物を均質化熱処理することを特徴とする軽金属合金射出成形材の製造方法。

【請求項５】　軽金属合金が母材がマグネシウムであって、合金成分として少なくともアルミニウム５重量％以上を含有する請求項４記載の製造方法。

【請求項６】　軽金属合金が固相率７０％以下の半溶融状態で射出成形される請求項４記載の製造方法。

【請求項７】　均質化熱処理条件が射出成形品の粒界に存在するＭｇＡｌ化合物を母材に固溶させるに十分な３００～５００℃×３０分～１０時間の範囲内である請求項４記載の製造方法。

【請求項８】　請求項３記載の軽金属合金射出成形材を据込み率６０％以上の鍛造工程に付して製造される軽合金鍛造製品。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、軽金属合金、特に合金成分としてアルミニウムを含有するマグネシウム合金の成形性に優れた射出成形材およびその製造方法並びに軽合金鍛造製品に関する。

【０００２】

【従来の技術】アルミニウムまたはマグネシウムを母材とする軽金属合金、特にアルミニウムを合金成分とするマグネシウム合金は軽量でかつ鍛造等の塑性加工を施すことにより所定の機械的強度を確保できる素材として注目されている。しかしながら、通常の溶解鋳造法で型内に鋳込んだ鋳造品は鍛造等の塑性加工性に欠け、所定の機械的強度を確保するのが難しい。

【０００３】

【発明が解決しようとする課題】そこで、アルミニウムおよびマグネシムを含有する軽金属合金においてかかる塑性加工性に欠ける原因を探求すると、第1に、アルミニウムおよびマグネシムが併存する場合は粒界に$Al_{12}Mg_{17}$で示される化合物が生成し、これが塑性加工性に影響を与える。他方、溶解鋳造法で鋳込んだ鋳造品にはマグネシム初晶α相がないが、固相／液相が共存する半溶融状態で射出成形した成形品にはマグネシム初晶α相が存在する。したがって、この初晶α相の存否が上記ＡｌＭｇ化合物の影響を緩和し、塑性加工性の向上に影響を与えるものと思われる。第２に、上記マグネシウムの初晶α相の粒径は固相／液相比率である固相率が小さくなるに伴い小さくなるが、それだけでは塑性加工性の向上はそれほど認められない。しかしながら、均質化熱処理に付する場合、短時間処理で塑性加工性が著しく向上することが見出された。これは溶解鋳造法では認められなかった効果である。

【０００４】そこで、本発明の第１の目的は、塑性加工性を向上させるマグネシウムの初晶α相を有する軽金属合金射出成形材およびその製造方法並びに軽合金鍛造製品を提供することにある。本発明の第２の目的は均質化熱処理により塑性加工性を向上させることができる軽金属合金射出成形材およびその製造方法並びに軽合金鍛造製品を提供することにある。

【０００５】

【課題を解決するための手段】上記目的を達成するために、本発明は少なくともアルミニウムおよびマグネシウムを合金成分とする軽金属を母材とし、粒径５００μm以下のマグネシウム初晶α相を含むことを特徴とする成形性に優れる軽金属合金射出成形材を提供するものである。マグネシウムの初晶α相を生成させるためには射出成形を半溶融射出成形法に基づいて行う必要がある。ここで、半溶融射出成形法による射出成形とは、固相／液相が共存する半溶融状態あるいは合金の融点直上の温度で溶融状態とした後、射出成形することをいう。

【０００６】母材がマグネシウムである場合は、合金成分として少なくともアルミニウム５重量％以上を含有し、平均結晶粒径２００μm以下であるのが好ましい。アルミニウムが５重量％未満では、所定の機械強度が得られないからである。したがって、本発明において好ましいマグネシウム合金としては、ＡＳＴＭ規格のＡＺ６１，ＡＺ８０，ＡＺ９１等、Ｍｇ－Ａｌ－Ｚｎ系合金が挙げられる。また、平均結晶粒径が２００μm以上では塑性加工性の一つである鍛造時の限界据え込み率が５０％以下となるためである。

【０００７】特に、マグネシウム初晶α相が粒径１２０μm以下であって、均質化熱処理にて実質的にＭｇＡｌ化合物を母材に固溶してなる射出成形材は従来の溶解鋳造法では得られなかった成形性の向上が認められ（図１参照）、射出成形材を直接鍛造成形に付すことが可能で、鍛造に至るプロセスを簡略化することができる。

【０００８】本発明は、少なくともアルミニウムおよびマグネシウムを合金成分とする軽金属合金を固相／液相が共存する半溶融状態あるいは合金の融点直上の温度で溶融状態とした後、射出成形し、その成形物を均質化熱処理することを特徴とする軽金属合金射出成形材の製造

方法を提供するものでもある。

【０００９】本発明方法は、特に軽金属合金が母材がマグネシウムであって、合金成分として少なくともアルミニウム５重量％以上を含有する場合に有効であり、固相率７０％以下の半溶融状態で射出成形されると、マグネシウム初晶α相が粒径１２０μm以下となり、均質化熱処理効果が発揮されるようになる（図１参照）。

【００１０】均質化熱処理の条件は射出成形品の粒界に存在するＭｇＡｌ化合物を母材に固溶させるに十分な３００～５００℃×３０分～１０時間の範囲内で選ばれる。すなわち、ＭｇＡｌ化合物の粒径及び（合金成分に関係する）量、成形品の質量などを考慮すべきである。

【００１１】本発明によって得られる軽金属合金射出成形材は限界据込み率６０％以上の成形性を有するので、直接鍛造工程に付し軽合金鍛造製品を製造することができる。

【００１２】

【発明の実施の形態】以下、本発明の実施の形態について、図面を参照しながら説明する。以下の組成を有するＡＺ８０のマグネシウム合金を用意し、図３に示す半溶融射出成形機（型式：ＪＬＭ－４５０Ｅ，株式会社日本製鋼所製）を用いて次の条件下に射出成形を行った。この射出成形機は成形材料の固相線温度より上であって液相線温度より下の温度にスクリュー押出機中で合金を加熱して半溶融状態とし、高速射出機構により金型キャビティ内にショットするものである。

【００１３】

【表１】

マグネシウム合金組成

（単位：重量％）

	Al	Zn	Mn	Fe	Si	Cu	Ni	Mg
合金A	8.1	0.45	0.27	0.0018	0.03	0.0025	0.0009	Bal.

【００１４】

【表２】射出成形条件

射出圧	８０ＭＰａ
射出速度	２ｍ／ｓｅｃ
ゲート速度	４８ｍ／ｓｅｃ
金型温度	１８０℃

【００１５】マグネシウム合金は切削して切粉状となし、ホッパーに投入されるが、固相率（固相／液相）はシリンダー内の加熱温度で調整した。種々の固相率における射出成形品の初晶α相の成否を顕微鏡写真で確認するとともにその平均粒径を測定した。結果は以下の表３の通りである。

【００１６】また、上記射出成形したままの材料と均質化熱処理（４００℃×１８０分間）後空冷した材料とを以下の鍛造成形性評価方法により試験した。その結果、固相率７０％以下で初晶α相１２０μm以下となり、固相率の低下とともに初晶α相の粒径は小さくなるが、成形性の向上はほとんど見られない。しかしながら、初晶α相が１２０μm以下から均質化熱処理効果が発揮され、初晶α相の粒径が小さくなる程その向上は著しいことが分かった。上記鍛造成形性評価方法としては、円柱状テストピースを用いた据え込み試験により求めた限界据え込み率により評価する方法を用いた。即ち、直径１６ｍｍ、高さ２４ｍｍの円柱状テストピースを、高さ方向に据え込み鍛造し、テストピースの割れが生じる時の高さＨを測定し、以下の式（I）

【数１】

$$限界据え込み率（\%）=（（24-H）/24）\times 100 \quad (I)$$

より限界据え込み率を求めて評価した。

【００１７】

【表３】

初晶α相と鍛造成形性

固相率	１０％	２０％	４０％	７０％	８０％
初晶α相					
平均粒径（μｍ）	４５	３５	７５	１２０	１４０
第１成形性	７０％	６６％	６４％	６０％	５７％
第２成形性	８７％	８５％	７２％	６２％	５６％

なお、第１成形性とは均質化熱処理前の３００℃における成形性（限界据え込み率）をいい、第２成形性とは均質化熱処理後の３００℃における成形性（限界据え込み率）をいう。

【００１８】以上の結果をグラフにすると図１に示す通りである。また、均質化熱処理前後の成形性の変化を固相率１０％と７０％の場合と同一組成のマグネシウム合金を連続鋳造した場合とを比較すると図２に示す通りである。すなわち、本発明以外では初晶α相の存在が認められないので、均質化熱処理の効果は認められず、本発明の場合でも固相率７０％以下で均質化熱処理効果が発揮され始め、固相率が低下するほど初晶α相の粒径が小さくなり、次第に成形性が向上することが認められる。

【００１９】上記マグネシウム合金を用い、固相率１０％で射出成形した半溶融射出成形材Ａ（図４）、固相率７０％で射出成形した半溶融射出成形材Ｂ（図５）、ダイカストした場合Ｃ（図６）および金型鋳造（連続鋳造）した場合Ｄ（図７）を比較すると、前二者では初晶

α相が認められるのに、後二者の場合は初晶α相が認められない。

【００２０】また、上記半溶融射出成形材ＡおよびＢでは４００℃で３時間という比較的短い均質化熱処理で粒界に存在する$Mg_{17}Al_{12}$化合物がほとんど固溶して消失する（図８および図９参照）のに対し、金型鋳造材Ｄの場合は４００℃で６時間均質化熱処理を施してもほとんど固溶しない（図１０参照）。この結果は均質化熱処理の成形性の向上の存否に現れている。

【００２１】以上ＡＺ８０マグネシウム合金について種々の効果を確認したが、このマグネシウムの初晶α相はマグネシウムとアルミニウムを含有する軽合金を半溶融射出成形法で射出成形する限り晶出するものである。また、マグネシウムとアルミニウムを含有する軽金属合金を溶解鋳造する限り粒界に存在する$Mg_{17}Al_{12}$化合物が析出する。したがって、本発明方法は広くマグネシウムとアルミニウムを含有する軽金属合金に適用可能である。

【００２２】

【発明の効果】以上説明したように本発明によれば、少なくともマグネシウムとアルミニウムとを含む軽合金において、射出成形によりマグネシウムの初晶α相が存在し、連続鋳造に比して優れた成形性を示す。特に上記初晶α相が１２０μｍ以下の場合は、粒界に析出する$Mg_{17}Al_{12}$化合物が均質化熱処理により母材に固溶して消失するので、より優れた成形性を示すことになる。このような本発明射出成形材を用いることにより鍛造成形が容易になり、マグネシウム合金の鍛造品を提供することができる。

【図面の簡単な説明】

【図１】　ＡＺ８０マグネシウム合金の半溶融射出成形における固相率と初晶α相の平均粒径、均質化熱処理前後の成形性の関係を示すグラフ。

【図２】　本発明による均質化熱処理前後の成形性に及ぼす効果と連続鋳造における均質化熱処理前後の成形性に及ぼす効果とを対比したグラフ。

【図３】　本発明で用いる半溶融成形機の概略図である。

【図４】　固相率１０％で射出成形した半溶融射出成形材Ａの組織を示す顕微鏡写真である。

【図５】　固相率７０％で射出成形した半溶融射出成形材Ｂの組織を示す顕微鏡写真である。

【図６】　ＡＺ８０マグネシウム合金のダイカスト材の組織を示す顕微鏡写真である。

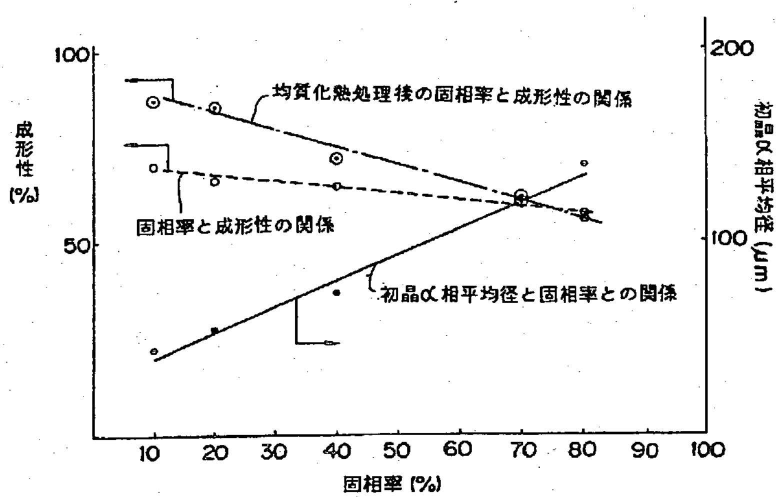
【図７】　ＡＺ８０マグネシウム合金の金型鋳造材の組織を示す顕微鏡写真である。

【図８】　図４で示す半溶融射出成形材を均質化熱処理した後の組織を示す顕微鏡写真である。

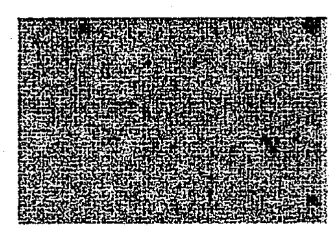
【図９】　図５で示す半溶融射出成形材を均質化熱処理した後の組織を示す顕微鏡写真である。

【図１０】　図７で示す半溶融射出成形材を均質化熱処理した後の組織を示す顕微鏡写真である。

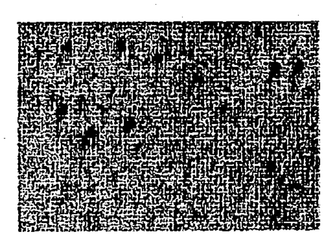
【図１】



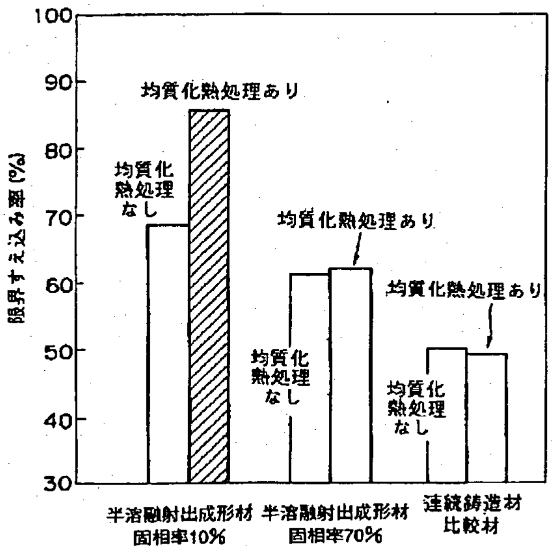
【図４】



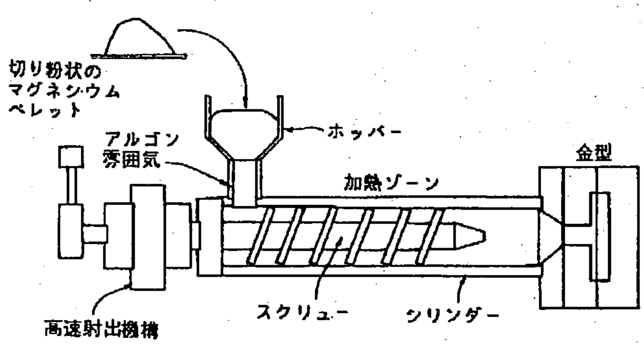
【図５】



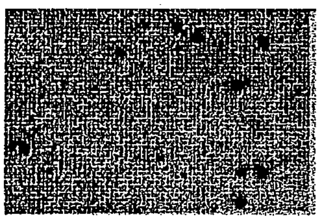
【図２】



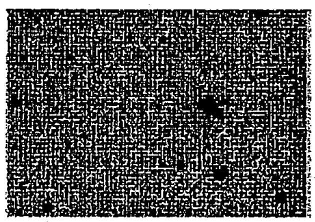
【図３】



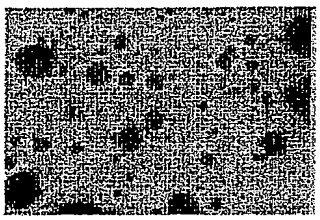
【図８】



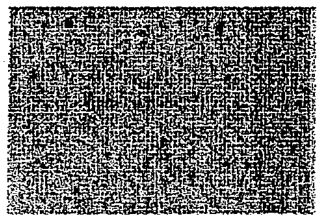
【図９】



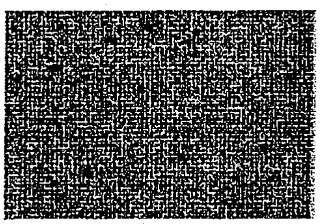
【図６】



【図７】



【図１０】



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	６８１		６８１
	６８３		６８３
	６９１		６９１Ｂ
			６９１Ｃ